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Renewable Energy Best Practices in Promotion and Use for Latin America and the Caribbean

Andrea Luecke

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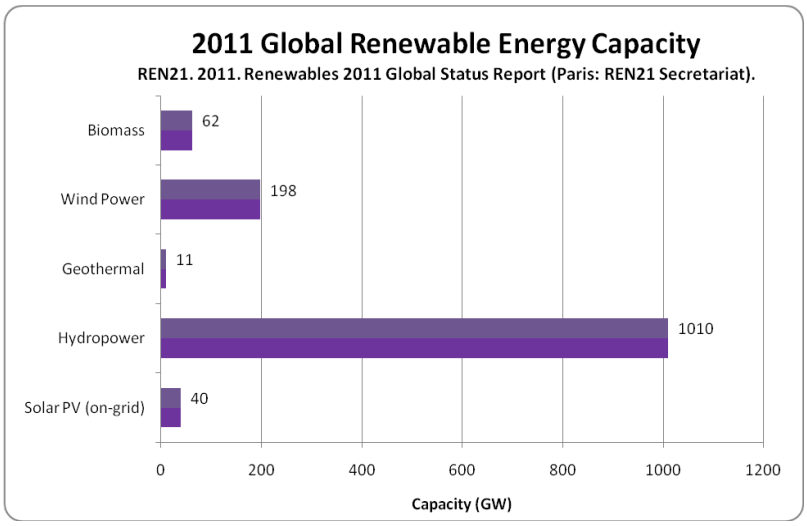
Abstract

The global energy market is in the midst of a dramatic evolution, slowly shifting away from an economy based on fossil fuels that relies on cheap fuel and resource extraction toward a market economy focused on sustainability, reliability, innovation, and energy independence. Although renewable energy[a] only makes up 16 percent of the world's energy production, there is nearly 1,320 GW of renewable energy capacity worldwide, employing over 3.5 million people (Renewable Energy Policy Network for the 21st Century [REN21], 2010). The evolution toward clean energy has inspired generations and, as a result, has become increasingly popular, growing by 1.9 percent per year over the past two decades (Meisen and Krumpel, 2009).



According to the Renewable Energy Policy Network for the 21st Century (REN21), the number of countries with policies directed at promoting renewable energy has doubled over the past five years (REN21, 2011). The United States, along with European and Asian countries, is actively promoting renewable energy to catalyze and achieve profound economic and environmental changes. By contrast, the countries of Latin America and the Caribbean (LAC) have been slow to adopt renewable energy because of poverty, lack of awareness, and lack of government support to mitigate climate change, stabilize energy supplies, or invest in innovation (UN Industrial Development Organization, 2011). Although U.S. renewable energy markets are still emerging and over a dozen LAC nations rank higher than the United States in an Environmental Performance Index study (Yale University, 2010), there is a lot to be learned from the United States' experience in promoting clean energy technologies. A robust and comprehensive renewable energy market in LAC, equal to or greater than that in the United States, might not only trigger a wave of innovation, but could open previously untapped opportunities for economic growth. And, as with most new technology markets, the more the public and private sectors invest in renewable energy, the more affordable it becomes.

[a] Throughout this document, renewable energy is defined as biomass, wind power, geothermal, hydropower, and both solar electric (PV) and solar thermal.

For the purpose of this paper, all dollar amounts are in U.S. dollars, the term “Latin America” refers to all Central American and South American nations and Mexico, the term “Caribbean” refers to the island nations, and the acronym “LAC” refers to both Latin America and the Caribbean. Given this broad topic, this paper aims to present a snapshot of some of the best practices in the promotion and use of renewable energy, and provide practical examples of the development of renewable energy markets that countries in LAC can replicate. This brief study provides an overview of some of the most widely used renewable energy technologies. It also examines current and potential renewable energy markets in LAC, economic development benefits of expanding renewable energy markets, policy tools and mechanisms that have been used to build and promote renewable energy in the United States, and the role governments and the private sector can play. Finally, this paper presents a few recommendations for LAC countries. There are two tables in the appendices. One shows where renewable energy incentives exist in LAC and the other where renewable energy markets are in active development in LAC.

This paper benefitted from the editorial input of Sheila Mahoney.

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Overview of Common Renewable Energy Technologies

Bio-energy: Biofuel and biomass energy constitute the fastest growing renewable energy sectors in the world. A range of organic waste products or other organic matter (wood chips, excess vegetation, excess cooking oil, sugar cane, soy beans, etc.) can be burned and converted to energy at an 80–90 percent efficiency rate to produce electricity or fuel (Biomass Thermal Energy Council, 2010). This makes biomass a very attractive fuel option in less-developed regions where conventional fossil fuel resources, such as butane or kerosene, are limited or expensive but resources such as organic plant or animal waste are abundant and cheap to obtain. In the United States, some utilities are converting human waste, trapping liquefied gas, and/or farming algae to produce electricity and fuel in the same manner.

Wind Energy: Electricity produced by wind turbines is also on the rise. In 2010, 40 percent of all new electricity capacity added to the U.S. grid was produced from wind power projects (AWEA, 2011). The global wind energy industry has grown at a rate of roughly 25 percent per year since 1990, making wind energy the second fastest growing renewable energy sector worldwide (Meisen and Krumpel, 2009). While some wind power systems are ideal for residential use, most of the electricity generated from wind power is from larger, utility-scale systems.

Geothermal Energy: Because it is largely underground, geothermal energy is one of the least publicly understood renewable energy sources. However, there is enough global geothermal capacity currently in production to power 5.7 million homes per year (REN21, 2011). By tapping the heat below the earth's surface, electricity can be generated using a steam turbine, while pumps can capture heat for residential and commercial use. Geothermal systems can also use the ambient temperature found just a few meters underground, where the air is at a constant 55 degrees Fahrenheit. Sites near plate boundaries or volcanic activity are especially well suited for geothermal electricity production.

Hydropower: Hydropower is the most commonly used renewable energy source. In 2008, 15 percent of all electricity worldwide was produced by hydropower (REN21, 2011). Hydropower uses moving water and gravity to produce electricity from a turbine. Some analysts, however, do not consider hydropower to be a sustainable energy source because of the environmental impacts of creating dams that can disrupt the natural flooding patterns of lakes and rivers, causing unintended damage both up- and downstream.

Solar Energy: The U.S. solar industry saw 67 percent growth from 2009 to 2010, making it the fastest growing energy sector and one of the fastest growing industries in any sector in the United States (Solar Energy Industries Association and GTM Research, 2010). Solar energy uses

either sunlight or the heat from direct sunlight to produce electricity or generate energy for heating or cooling. Solar photovoltaic panels produce electricity while concentrating solar power (CSP) systems use highly reflective mirrors to concentrate the sun's energy to heat a medium that can be used to power a turbine and produce electricity on a utility scale. Finally, solar heating and cooling (SHC) systems can be used to heat or cool air or water for buildings and pools. Germany has the world's largest solar market and gets nearly 2 percent of its total electricity from solar. On the other hand, solar only makes up about 0.01 percent of the United States' energy mix. Although Germany is not particularly sunny, it has installed 17,000 MW while the entire United States has installed a mere 1,000 MW.

Energy in Latin America and the Caribbean

With so many countries, tax structures, electricity rates, political ideologies, geographic conditions, and national sentiments, it is difficult to make generalizations about the energy sector in LAC. The only appropriate generalization is that fossil fuels and established forms of renewable energy, such as hydropower and biomass, play such a large role in LAC that newer, less established renewable energy technologies face major obstacles to gaining market share. In the Caribbean, roughly 93 percent of commercial energy consumption is petroleum products (Fevrier, 2011) and over 97 percent of overall electrical power is generated by fossil fuels (Schwerin, 2010). Considering many analysts calculate that worldwide peak oil production has already occurred,[b] continued dependence on these dwindling resources creates national energy and economic security challenges for import-reliant nations. With the exception of Trinidad and Tobago, most Caribbean nations must dedicate large portions of their national GDP to importing energy (Schwerin, 2010). In the Caribbean, national GDP ranges from $0.4 billion in Dominica to $45.8 billion in the Dominican Republic (Gerner and Hansen, 2011). To put this into perspective, ExxonMobil's 2010 revenue was $383 billion (Krass, 2011).

To make matters worse, regional electricity generation will have to increase by 145 percent by 2030 to accommodate population growth and the accompanying 75 percent increase in energy demand predicted by the Inter-American Development Bank (Arnson, Fuentes, and Rojas Aravena, 2008). This will be especially applicable to nations such as Haiti, where low electricity rates and large populations already increase demand for power. Additionally, energy costs in the region are generally controlled by private utility companies that have enjoyed long-standing monopolies. Energy costs in the Caribbean are among the highest in the world, with estimates

[b] Peak oil is defined as when the maximum rate of global petroleum extraction is reached and the rate of production starts to decline.

ranging from as low as $0.20 per kWh (Schwerin, 2010) in Trinidad and Tobago to as high as $0.38 per kWh (McClintock, 2011) in Barbados.[c] Comparatively, the average cost for electricity in the United States is approximately $0.12 per kWh. Considering the cost of power, it is no surprise that off-grid diesel generators, which cause significant pollution, are so commonplace. Although the high cost of energy negatively affects many people and businesses (34 million people are without electricity in LAC), high energy costs can be a tremendous catalyst for renewable energy production. Hawaii, for example, has the most expensive electricity in the United States at $0.25 per kWh. As a result, the state has made an aggressive push for more renewable energy incentives and policies, creating, in the process, one of the most robust renewable energy markets in the United States.

Notwithstanding the economic and security benefits, there is another compelling reason for Caribbean nations to incorporate renewable energy into their energy portfolio: climate change. It is estimated that a 0.5 meter rise in sea level will submerge 38 percent of Caribbean beach land (Schwerin, 2010). This seemingly insignificant increase in sea level could have dramatic effects on people's access to energy, their livelihoods, and their basic safety.

Renewable Energy Markets in Latin America and the Caribbean

Because renewable energy is locally sourced, clean, and abundant, it is considered a means to increasing energy security, yet renewable energy in LAC accounts for only 23 percent of the region's total energy production (UNEP, 2010). South America generates almost 29 percent of its energy from renewable sources, which, compared to the global renewable energy production average of 13 percent, is impressive (Meisen and Krumpel, 2009). However, the majority of South America's production comes from hydropower and bio-energy, which are both associated with negative environmental effects.

- Hydropower energy production is not reliable during long periods of drought or low rain levels and can affect flood cycles of rivers and waterways, thereby, increasing the chance of drought.
- Biomass is often obtained from deforestation or through other non-sustainable methods. For example, nearly 40 percent of Guatemala's energy is wood-fuel obtained by what are arguably considered non-sustainable de-forestation methods. Furthermore, bio-energy crops such as sugar cane and soy necessitate the use of fertilizers that contain nitrates and phosphates that cause pollution run-off. Finally, because it takes

[c] Other countries with high electricity costs include Guyana, Saint Kitts, Nevis, and Puerto Rico.

approximately one gallon of gasoline to produce one gallon of ethanol, the fuel, although better than petrol, is not as sustainable as other renewable energy sources (Tickell, 2008).

This is not to say that solar and wind have no associated environmental effects, but their impact tends to be less than large-scale hydro and bio-energy applications.

To help foster strong, sustainable and vibrant renewable energy markets in LAC, various organizations and programs have been formed. Although there are many other organizations working to promote renewable energy, the following are some of the most prominent agencies:

- The Caribbean Renewable Energy Development Programme (CREDP), based in Saint Lucia, was created in 1998 and consists of 16 Caribbean countries that aim to break down market barriers and nurture the commercialization of renewable energy.
- The Caribbean Council for Science and Technology (CCST), based in Trinidad, connects national governments in commercializing science and technology innovations. Since 1980, CCST has helped facilitate the mutual transfer of technologies across national borders.
- The Institute of the Americas (IOA) was formed 25 years ago to encourage information sharing in energy and technology markets between the United States, Canada, and Latin America.
- The Latin American and Caribbean Council on Renewable Energy (LAC-CORE) functions as a platform for interaction in LAC through the organization of conferences, webinars, seminars, workshops, forums, and trade shows. Additionally, LAC-CORE provides industry leaders in the region with expert information on the adoption of renewable energy technologies.
- The Worldwatch Institute's Energy and Climate program is promoting renewable energy in the Dominican Republic and Haiti. Work in the Dominican Republic includes a renewable energy roadmap for the National Energy Commission.
- The Latin American Wind Energy Association (LAWEA) provides information about the wind market throughout Latin America to promote the industry and help bring in foreign investment.

Efforts like these have led to modest growth in the region's renewable energy industry. Though some renewable energy sectors are growing faster than others, globally renewable energy use is on the rise. According to the United Nations Environment Programme (UNEP), investment in renewable energy grew 32 percent in 2010, and the global industry is valued at a record breaking $211 billion. Interestingly, UNEP also found that developing countries are investing in

renewable energy *faster than developed countries* (Burger, 2011). Understanding the role renewable energy plays in LAC is critical in determining the best way to move the region toward a clean energy economy.

Bio-energy

Current: Biofuels are by far the dominant renewable energy source in LAC, accounting for over 12 percent of the region's total energy portfolio (UNEP, 2011). Brazil produces almost all of the world's supply of sugar-derived ethanol fuels (REN21, 2011). Other major biofuel producers and consumers include Guyana, Honduras, Nicaragua, El Salvador, and Colombia (Meisen and Krumpel, 2009). Today, 50 percent of Barbados' energy supply is renewable sugarcane waste and bagasse (the fibrous matter that remains after sugarcane stalks are crushed to extract their juice) (Meisen and Krumpel, 2009).

Potential: Expanding sustainable biomass and biofuel markets is well within the grasp of LAC countries. However, traditional energy practices that are non-sustainable, as in the case of Guatemala's use of wood-fuel, should be eliminated or converted to more sustainable practices. Considering the agriculture infrastructure that is already in place, there is considerable market potential for biogas development. For example, one 400 kilogram farm animal, such as a cow, can produce up to 20 kilograms of solid waste per day. The waste can be used in a digester that uses naturally occurring gases from the decomposition process to generate energy. This is also true of plant waste. Existing maps of farmland could be used as a reference for implementing a sustainable biogas market. Furthermore, there is great potential for LAC countries to grow algae and convert human waste or landfill gas into sustainable fuel sources.

Wind

Current: Wind markets in Latin America are either underdeveloped or not developed at all. While Brazil and Argentina have developed wind maps to encourage development, few investors have shown interest. In 2008, Brazil and Uruguay were the only nations in South America to have installed large-scale wind farms. Caribbean wind markets are substantially more developed. Despite being a small island nation, Barbados, a renewable energy champion in the Caribbean, began using wind energy to pump water into irrigation systems as long ago as the 1600s (Schwerin, 2010). Additionally, the Dominican Republic has roughly 100 MW (with 63 MW currently under development) and Jamaica has another 20 MW of wind energy capacity currently installed (Gerner and Hansen, 2011).

Potential: There is terrific potential for developing a wind market in LAC. While some localities are conveniently exposed to global trade winds, others experience temperature fluctuations

that, when coupled with elevation changes, can produce strong and reliable wind year round. The Dominican Republic is estimated to have roughly 3,200 MW of potential wind power available over 460 square kilometers. Wind potential in Brazil is expected to supply the country with roughly 4.7 GW of capacity by 2030 (World Bank, 2010). Other countries in LAC likely have as much potential. To understand where to best locate future wind infrastructure, more comprehensive resource mapping (which requires government and private sector investment) is needed.

Geothermal

Current: Geothermal power generation in LAC accounts for only 0.5 percent of the region's energy supply (UNEP, 2010) and is heavily dictated by a country's proximity to plate boundaries, volcanoes, and hot spots. Geothermal power does, however, play a large role in some countries' energy portfolios. In Costa Rica, for example, more electricity is derived from geothermal sources than fossil fuels (McDermott, 2009), thanks to the country's convenient location near the Circum-Pacific Seismic Belt (CPSB). Small-scale geothermal power generation can be found elsewhere around the CPSB in El Salvador, Mexico, and Nicaragua, but still does not play a dominant role. Geothermal power generates over 3,189 GWh of electricity per year in the Caribbean. Guadeloupe, for example, has had a 15 MW geothermal plant since 1986. Projects are also found in Saint Lucia, Dominica, and Nevis. In the Caribbean, geothermal power could potentially lower electricity costs to $0.15 per kWh (Gerner and Hansen, 2011).

Potential: With its multiple plate boundaries, Mexico has tremendous geothermal potential. The coasts of Colombia and Ecuador also have a number of potential geothermal sites where the Nazca and South American tectonic plates meet. Furthermore, nations in the eastern and northern-most parts of the Caribbean are well situated for geothermal power production, with between 450 MW and several thousand megawatts of potential capacity (Gerner and Hansen, 2011). Nevis and Grenada, for example, have an estimated 300 MW and 400 MW of potential capacity, respectively, that has yet to be developed (Gerner and Hansen, 2011). CREDP has been exploring strategies to develop geothermal systems in Saint Kitts, Nevis, Dominica, and Saint Lucia. Some estimates predict up to 300 TWh per year of geothermal power is possible in LAC (Yepez-Garcia, Johnson, and Andres, 2010), and a developed geothermal market in the Caribbean could provide electricity that would cost $0.12 to $0.15 per kWh (Joseph, 2008).

Hydropower

Current: Hydropower plays an extensive role in LAC's current energy portfolio, accounting for roughly 8.5 percent of the region's total energy supply (UNEP, 2010). Large hydro dams provide substantial electric power for many countries, while existing as *the only* renewable energy

source in other countries. Micro-hydropower uses small-scale hydro generation technology that produces up to (but typically not more than) 100 kW of electric power. Because of their small size, the environmental impact of these technologies is smaller than their larger counterparts, which has led to a recent increase in popularity. In LAC, almost all countries have developed hydropower infrastructure. In the Caribbean, hydropower is used by Dominica (7.6 MW), Haiti (62 MW), Jamaica (43 MW), the Dominican Republic (472 MW), and Saint Vincent (6 MW), to name a few (Gerner and Hansen, 2011).

Potential: Hydropower holds great potential in South America, especially around the Andes and other regions with substantial elevation changes. While these elevation changes are not as common in the Caribbean, there is still potential. For example, even in countries where hydropower already exists, the market can be expanded. Notwithstanding, all nations must be cognizant of the problems associated with hydropower during periods of drought, low rainfall, or excessive energy use, as well as the damage to the ecosystems both up- and downstream of dams.

Solar

Current: A few countries, including Mexico, Argentina, and Colombia, have developed solar irradiance maps to show where solar energy production is best suited and to encourage industry development. Beyond acknowledging the potential for a solar energy industry, it remains only a niche market in select countries such as Barbados, Saint Lucia, and Grenada. This lack of market development in other countries is most likely caused by the high cost required to install solar power – a problem that can be addressed by smart policies. The more common use of solar energy technology in the Caribbean is for heating water in homes. In 2009, two out of every five homes in Barbados had a solar water heating system installed, making Barbados the third highest per capita user of solar water heaters in the world. Achieving this, however, was not a simple task. As seems to be the case throughout the Caribbean, great effort went into educating and informing the public on how solar water heaters work and assuring the residents that they are safe and reliable (Schwerin, 2010). Barbados' high electricity rates were also a factor in adopting solar. Countries with lower electricity rates, such as Trinidad and Tobago, will inevitably have more difficulty transitioning toward renewable energy.

Potential: In terms of availability and potential, solar energy stands to play a large role throughout Latin America, the Caribbean, and the world. The U.S. Department of Energy (DOE) states that in one hour enough sunlight falls on the surface of the earth to power all of the earth's electrical needs for a year (DOE, 2011a). Germany is the world's largest solar consumer and producer, yet its solar resource is inferior to that in most of the Western Hemisphere. In

fact, Germany's solar resource is on par with Alaska's. If a sustainable and vibrant solar market is to take root, long-term institutional, financial, and other necessary infrastructure must be put in place.

In its 2010 paper "Analysis of the Potential Solar Energy Market in the Caribbean," CREDP identified a number of obstacles and first-step requirements for a suitable retail solar energy market to develop in the Caribbean. The main obstacles identified were lack of information and lack of resources (financial, grid development, and workforce). CREDP recommends that, to overcome these obstacles (commonly found throughout the world), nations need to

- educate the general public and local governments about solar technologies;
- compile an inventory of how much solar is already installed and how much more solar is possible (in MWs);
- understand the availability of resources and current infrastructure;
- put the appropriate institutional support in place to facilitate and encourage such a market.

CREDP points out that these four recommendations can be applied to all the renewable energy technologies, not just solar.

Economic Development Benefits of Expanding Renewable Energy Markets

There are direct and indirect benefits inherent in the formation of a comprehensive renewable energy industry. Saving energy and money are considered direct benefits. In Manlius, Illinois, for example, a 660 kW wind turbine produces enough electricity to save the local school system over $100,000 per year in avoided fuel and electricity costs (*Windustry*, 2006). Keeping in mind that nearly 75 percent of all clean economy jobs in the United States are located in the top 100 largest metro areas, densely populated urban areas in LAC will likely have the most opportunity to generate direct or indirect economic development benefits (Muro, Rothwell, and Saha, 2011).

Job Creation

As the world continues to recover from the global recession of 2008, job creation becomes increasingly important. Globally, biomass employs approximately 1.7 million people, solar employs approximately 665,000, wind employs approximately 630,000, hydropower employs approximately 40,000, and geothermal employs approximately 20,000 people (REN21, 2011). Due to the demand for more renewable energy, Germany expects more jobs in renewable

energy than in the automotive industry within the next decade, signifying a shift in national priorities. The United States is experiencing its own shift. According to The Solar Foundation, the U.S. solar industry currently employs over 100,000 workers (The Solar Foundation, 2010), which is more than the U.S. steel production sector. These jobs are spread across the entire value chain and include everything from lawyers and accountants to manufacturing, roofing, and plumbing.

Although U.S. manufacturing jobs are at their lowest since before World War II, approximately 26 percent of all clean jobs are in manufacturing (Muro et al., 2011). Solar manufacturing jobs are expected to grow 14 percent between 2011 and 2012 (compared with overall manufacturing, where jobs are expected to decline by 2.6 percent over the same period) (The Solar Foundation, 2010). It is not easy to compete with Asia on low-cost manufacturing, but at least one Latin American nation, Mexico, is beginning to attract multinational renewable energy manufacturers because of its lower-cost labor and less stringent environmental regulations. In 2009, Japanese company Sanyo, for example, opened a solar photovoltaic (PV) module manufacturing plant in Nuevo Leon, Mexico, to reduce manufacturing costs for products supplying the U.S. and Canadian markets (Renewable Energy World, 2009).

Exports and Direct Value

Manufacturing renewable energy products can lead to export opportunities. A report released by the Solar Energy Industries Association and GTM Research in August 2011 found that the United States is a net exporter of solar energy products and is the world's leading exporter of polysilicon for solar PV panels (much of which Germany imports). These exports pump money back into local economies in the form of direct value. Although the entire market grew to $6 billion in 2010, the report also found that, in 2010, the U.S. solar industry created $4.4 billion in domestic direct value, signifying that $0.75 out of every $1 spent on a U.S. solar installation found its way back to the local U.S. economy through wages paid to domestic manufacturers, installers, etc. By investing in locally grown and produced energy sources, money that would otherwise be spent on energy imports can be saved, capitalized on through return investments, or spent on small business enterprises and national infrastructure projects. As renewable energy manufacturing increases and trade connections are created, direct value begins to accumulate, helping to contribute to a nation's GDP.

Land Ownership, Property, and Asset Value

One of the most basic by-products of renewable energy is an increase in property and asset values. In the United States, there is new evidence that the presence of a solar PV system on a house leads to greater resale value. In California, homes with a 3 kW PV system sold for an

average of $17,000 more than comparable homes without PV (Hoen et al., 2011). And despite being restricted by local laws, landowners that lease their property to project developers for wind, solar, geothermal, or hydropower are often able to profit. The City of Chicago, Illinois, leased a 40-acre plot of former industrial land (land with limited reuse value) to its local utility to build a solar farm and will bring in $110,000 in revenue per year through the arrangement. The City of Las Cruces, New Mexico, is also working on a solar land lease and stands to earn $2.3 million over the life of the project.

Improved Regional Economic Competitiveness

A new renewable energy market can also stimulate regional economic competiveness by inducing new private capital investments. According to Bloomberg New Energy Finance, in the year ending June 2011, new investment in clean energy rose 22 percent (now at $41.7 billion globally) (Downing, 2011). A successful renewable energy market would help stabilize long-term energy prices, acting as a hedge against rising electricity rates. Reliance on energy imports would also be reduced, thus saving ratepayers' money. A manufacturing firm, for example, may choose to locate in a region with abundant *clean* electricity to avoid costly environmental controls or regulations. Finally, the existence of one or two renewable energy businesses in a region can create a clustering effect of companies that operate up and down the supply chain. All this helps to make a region more economically attractive, and therefore competitive.

Market Drivers and Best Practices

Although renewable energy's role in the U.S. energy economy is highly publicized and hotly debated, it is still an emerging phenomenon, facing formidable obstacles in achieving scale. In the absence of a national clean energy standard (or other national standards that mandate rate design, job training, permit issuance, financing underwriting criteria, etc.), fragmentation persists. The primary result of fragmentation is increased cost to implement renewable energy. In the absence of national standards and/or transparent processes, the time it takes each state and/or authority having jurisdiction (AHJ) to design individualized policies and programs drives up the cost of implementation. It also increases the level of complexity for renewable energy contractors, as each state and/or AHJ may operate under different rules and regulations (again, increasing the cost of the renewable energy system). Even though some renewable energy technologies, such as solar, are rapidly becoming more affordable (and in some U.S. states are equally as affordable as conventional fuels [Matz, 2010]), the high cost of renewable energy is still a barrier in most parts of the country.

In an effort to cultivate vibrant renewable energy markets in the United States, best practices in program development, rate design, financing, permitting, workforce development, and industry engagement have emerged. In the United States, AHJs with municipally owned utilities have more policy options because municipalities can directly affect utility operations and practices. Conversely, AHJs have less control over investor-owned utilities, which are regulated by state public utilities commissions. Regardless, supportive and transparent policies and programs at all levels of government are an important aspect of the advancement of renewable energy. The following highlights a few of the financial, regulatory, and industry best practices that hold the most promise for transforming the renewable energy market in LAC.

Renewable Portfolio Standard

Concept: Political will and utility participation are two of the most important factors in the development of renewable energy in the United States. Without these, a national clean energy standard, or a Renewable Portfolio Standard (RPS), may never be adopted. An RPS is a regulation passed and enforced at the state level that requires a certain percentage of energy production to be from renewable energy sources by a specific date.[d]

In practice: In the United States, 39 states and the District of Columbia have enacted an RPS or comparable standard. California's goal is to have 33 percent of its energy needs supplied by renewable sources by 2020, while New York's goal is 29 percent by 2015. In November 2004, Colorado became the first state to create an RPS by *ballot initiative* when voters approved Amendment 37. Since 2004, Colorado's RPS has been increased twice by ballot initiative, signifying how important renewable energy is to voters. A direct result of a state adopting an RPS is its ability to establish tradable renewable energy credits (RECs), an important market-driven mechanism for driving down the overall cost of a project. In New Jersey, solar renewable energy certificates (SRECs) have been largely responsible for the boom of the state's solar market. SRECs allow developers to build solar farms and large-scale solar projects while receiving highly valued certificates for the electricity produced from them. Ultimately, this incentive lowers the cost of overall project development because it allows some of the initial project capital investment to be recovered through power production. SREC markets can be complicated to analyze and evaluate; however, solar businesses have arisen to meet these challenges through brokering, aggregation, and web-based auction systems. These

[d] Eligible technologies might include solar water heat, solar thermal electric, solar thermal process heat, photovoltaics, landfill gas, wind, biomass, hydroelectric, geothermal electric, geothermal heat pumps, municipal solid waste, solar light pipes, biomass thermal, anaerobic digestion, small hydroelectric, tidal energy, wave energy, and fuel cells using renewable fuels.

intermediary services command a price, but they may be worth it. The table below shows the 7 out of 40 countries in LAC that have an RPS.

	Existing renewable energy capacity in 2008	RPS Goal	Other
Argentina	35%	40% by 2015	1,000 MW by 2012 and 2,500 MW by 2016. 2012 goal includes: 500 MW wind, 150 MW biofuels, 120 MW waste-to-energy, 100 MW biomass, 60 MW small hydro, 30 MW geothermal, 20 MW solar, and 20 MW biogas
Brazil	85%	75–85% by 2020	
Dominican Republic	7%	10% by 2015 25% by 2025	Wind: 500 MW by 2015
Jamaica	5%	10% by 2010	
Mexico		7.6% by 2012	Wind power 4.34%, small hydro 0.77%, geothermal 1.65%, and biogas/biomass 0.85%
Nicaragua	27%	38% by 2011	
Peru		5% by 2013	

Source: REN21, 2011.
Note: Table may be incomplete.

Net Metering Regulations

Concept: Net metering has been a useful tool in advancing U.S. renewable energy markets because it allows customers to be fairly compensated for the energy they generate. In those states that allow it, net metering enables an electricity customer who has a renewable energy generating system to be credited for the excess energy their system produces and returns to the grid. Net metering can be tracked by simply enabling the customer's electric meter to "run backwards" as they produce electricity and "run forward" as they consume electricity. The customer is charged or credited the difference. Forty-three states in the United States have adopted net metering practices and regulations.

In practice: The State of Utah requires its only investor-owned utility, Rocky Mountain Power (RMP), to offer net metering to customers who generate electricity using solar, wind, hydropower, hydrogen, biomass, landfill gas, or geothermal energy. Net metering is available for residential systems up to 25 kW and non-residential systems up to 2 MW in capacity. RMP will issue a kWh credit for monthly net excess generation produced by the net metering facility and

apply that credit to the next billing period. Large commercial customers that produce excess generation may choose between valuing excess generation at a rate based on avoided costs or at an alternative rate based on utility revenue and sales (DOE, 2011b).

Federal Tax Credits and Grants

Concept: The Energy Policy Act of 2005 and American Recovery and Reinvestment Act of 2009 created tax incentives to encourage residential and commercial renewable energy development in the form of an Investment Tax Credit (ITC) and 1603 Treasury Program. The federal programs credit or grant a tax-paying entity 30 percent of the costs related to the installation of a qualified renewable energy system (DOE, 2011c).

In practice: Tax credits for residential renewable energy systems help stimulate consumer interest, while tax credits (or cash grants in lieu of tax credits) have been effective in sparking project development and initiating industry growth. Since these incentives were first implemented in 2006, the cost of solar PV panels has declined 29 percent, largely due to the surge of products in the market, driving the cost per unit down.

State and Local Rebate Programs

Concept: To promote renewable energy adoption, many states and AHJs provide direct funding for system design and installation. Utilities may also provide their own rebates with varying conditions or stipulations, many based on system performance, system certification, installer credentials, etc. Rebate programs offer customers the opportunity to recover some of their initial capital investment.

In practice: Wind energy is one of the great renewable energy success stories in the United States because of its versatility and range of applications. The Long Island Power Authority in New York manages a performance-based rebate program for residential and commercial wind installations. Residential installations may earn up to $3.50 per kWh for a maximum of 16,000 kWh per year, while commercial installations may earn a $0.50 per kWh rebate for annual production between 16,000 and 175,200 kWh.

Community and Group Purchasing

Concept: A community purchase occurs when more than one party shares in the ownership of a renewable energy system (usually wind or solar). A person may decide to participate in a community purchase if he or she resides in a home that is not suitable for individual renewable energy use. This concept is growing in popularity but is contingent on local laws, since utilities are often expected to split the energy bill among many users. In contrast, a group purchase is when

multiple parties wanting to purchase separate systems work together to place a bulk order. Working together allows them to benefit from wholesale equipment prices, reduced transaction costs, and greater ease in navigating the process.

In practice: Community and group purchasing have had immense success in Portland, Oregon, under the banner of the Solarize program. The program is designed to help individuals make informed decisions using a group dynamic. For example, the Solarize program helps to accelerate adoption of solar by facilitating the removal of some of the process decisions such as which contractor to hire, how large a system to purchase, how to pay for the system, or simply where to begin. Community programs not only successfully promote the adoption of renewable energy, but they also play a major role in educating people about its benefits. These types of programs are useful for regions (such as LAC) where there is a lot of public skepticism about new or foreign technology.

Third-Party Ownership

Concept: Third-party ownership arrangements are used by entities (such as governments, municipalities, schools, non-profits, or other tax-exempt organizations) that are not eligible to receive federal or state tax credits and benefits, those that prefer not to own and maintain a system, or those lacking the upfront capital needed to invest in wind or solar. In a third-party ownership arrangement, an entity hosts the system on its building or land, but the system is owned by a separate business or investor who uses the available tax credits and benefits and sells the power produced by the system to the host. Benefits of third-party ownership include:

- increased ability of non-eligible entities to take advantage of tax credits and depreciation benefits;
- upfront costs substantially reduced or eliminated;
- no responsibility for maintenance, operations, or sale of SRECs;
- third-parties can aggregate multiple investors to get discounts and better financing rates;
- predictable lower energy costs.

A disadvantage of third-party ownership may be high transaction costs for commercial-scale installations. Thus, third-party ownership in the commercial context has typically been limited to systems of 250 kW and above. Public agencies may also experience a variety of obstacles, including debt restrictions, contract restrictions, competitive procurement requirements, or optimal site access.

In practice: Sungevity is a U.S. company that offers third-party ownership in the form of residential solar leasing. Without any money paid up front, they design and install a customized residential system, then lease the panels to the homeowner for a low monthly rate. Although the homeowner does not own the system, the cost of the lease payment (plus the savings of the reduced electricity bill) is generally less than what the homeowner was paying before installing solar, signifying immediate cost savings. Other prominent companies offering third-party leases include SolarCity and SunRun.

Permitting and Interconnection Processes

Concept: While manufacturing innovations and technology breakthroughs have cut the cost of solar PV panels in half since 2009, the high cost of solar is still a frequently cited barrier to wider adoption. As a consequence, reducing process or "soft" costs (i.e., labor and overhead), which account for over half the cost of a residential solar installation, is now an industry focus. The DOE believes that by reducing soft costs (or the time it takes to site, permit, install, and interconnect a system), the cost of solar may be reduced to as low as $1 per watt by 2017. However, without national standards to follow, states and AHJs currently use their own set of procedures. The result is a patchwork of regulatory hurdles and processes, which, again, adds to the time and cost of installing a renewable energy system. Having an efficient, easily understandable standard and fair-cost set of processes that are managed by properly trained code officials will help to reduce these soft costs.

In practice: The best permitting practices include email and online transactions, fair flat fees, over-the-counter permit issuance, and standardized permit requirements (VoteSolar Initiative, n.d.). Implementing these best practices requires the full support of local jurisdictions that issue permits (Pitt, 2008). In 2007, the Sacramento Municipal Utility District (a municipal utility in California) pioneered streamlined permitting to ensure all AHJs in its service territory use a standard application template. Seven different AHJs signed on and developed measures that streamlined the process, including permitting fee waivers (for three years), a simple standardized application for small residential PV, and a commitment to over-the-counter or one-day turnaround for plan reviews (Cutlip, 2011).

Public and Private Sector Roles in Advancing Renewable Energy

The best practices outlined in the previous section did not occur overnight. They are the result of several decades of government and private sector involvement and cooperation toward advancing renewable energy in the United States. Although development of the renewable energy market remains a constant struggle for the United States, some policies and approaches are well suited for replication. Ensuring that the best possible legal, financial, regulatory, and institutional frameworks are in place is the responsibility of national governments and their private-sector counterparts. Informal unilateral actions by governments, although not binding to the international community, help to move renewable energy forward and should be considered.

Program Creation

The creation of a sustainable local renewable energy market requires a comprehensive and coordinated effort among many stakeholders. It is important to spend time in the beginning planning and analyzing, as the plan or roadmap that is created will serve as the legal and economic framework for renewable energy in the region for many years. It is of critical importance to engage a diverse group of stakeholders and advisors, such as local government, utilities, universities, business groups (local and foreign, small and large), entrepreneurs, international NGOs, banks, energy attorneys, concerned citizen groups, and more. Early engagement will help ensure active participation of all stakeholders in developing the plan, as well as personal investment in the long-term viability of the plan. The role of the advisors is to help develop a sustainable work plan and leverage resources. At a minimum, advisors should commit to providing in-kind consultation.

Public–Private Partnerships

While there is no strict rule for what makes a successful public–private partnership, team approaches are a proven way of encouraging renewable energy markets. Coordination among government agencies and the private sector at the national or local level is challenging but achievable. Recognizing and supporting community individuality, promoting cooperation, addressing common needs, and engaging in mutual problem solving are keys to success.

Creating and sustaining an attractive business-friendly market landscape is also essential for the successful establishment and continued growth of any new industry. Governments must understand the motivating factors for renewable energy companies to locate in a new market. Different incentives are required for companies in different phases of development. For example, an established foreign-owned manufacturing company will be interested in different perks or incentives than a domestic services company that is currently expanding.

The most important incentive for emerging industries and companies, perhaps, is government leadership. Some cities in the United States have incorporated renewable energy into their long-term comprehensive planning. This decision not only affects energy procurement for municipally owned buildings, but it also sends a message to renewable energy businesses that there is stability and certainty in the market. For a city or region working to attract investments, the perception of market stability is critical. Although the United States has not signed the Kyoto protocol, 1,054 U.S. mayors have demonstrated their commitment by signing the U.S. Conference of Mayors' Climate Protection Agreement, vowing to reduce carbon emissions in their cities below 1990 levels (U.S. Conference of Mayors, n.d.). Every country in LAC except for French Guiana and Puerto Rico has signed onto the Kyoto Protocol. Additionally, the Clinton Climate Initiative C40 Climate Leadership Group is a group of large cities committed to tackling climate change with commitments from a few U.S. cities, as well as Mexico City, Caracas, Bogotá, Lima, Buenos Aires, Rio de Janeiro, and São Paulo (Clinton Climate Initiative, 2011). Green energy goals, whether instituted by the government or the private sector, are often the first and most important step in showing leadership; however, these goals mean little without transparency and accountability.

Another example of a public–private partnership is the U.S. Environmental Protection Agency's (EPA) Green Power Partnership. This partnership supports the procurement of clean power (solar, wind, geothermal, some biomass, and low-impact hydropower) by companies. U.S. partner organizations that join must buy green power in amounts proportional to their annual electricity use. Partnering with the EPA can help small and large U.S. companies lower transaction costs associated with buying green power, reduce their carbon footprint, and communicate their leadership to key stakeholders (Green Power Partnership, 2011). Finally, the DOE recently launched its SunShot program, which is a collaborative national initiative to make solar energy technologies cost-competitive with other forms of energy. Through the SunShot program, the DOE will provide $50 million to U.S. manufacturers in an effort to reduce the cost of solar energy systems by 75 percent before 2020 (SunShot Initiative, 2011).

Public Education

Education is important in creating a retail renewable energy market, especially considering most of the world suffers from energy illiteracy. For example, many people in developed and developing countries alike do not know 1) how to read their utility bill, 2) where their energy comes from, 3) how renewable energy technologies work, 4) what the true costs of fossil fuels are, or 5) what a green job is. And they are not to blame. As a result of the abundance of cheap energy throughout the 20th century, especially in the United States, energy literacy campaigns

and efforts to promote the environmental benefits of renewable energy technologies have rarely been undertaken.

The DOE's Solar America Communities Outreach (SACO) Partnership program is an excellent example of a widespread public education and outreach effort. Essentially, SACO conducts outreach to local governments across the United States that are interested in implementing solar policies and programs. To best accelerate solar energy deployment, the DOE encourages local governments to take a comprehensive, holistic approach rather than a project-by-project approach. To support this, SACO implementing partners provide information to local governments about policies and regulations, financial incentives, workforce training best practices, and strategies for engaging utilities and members of the community. The DOE's *Solar Powering Your Community: A Guide for Local Governments* serves as the foundation for these public education efforts (Solar America Communities, 2011).

Workforce Development

Job training and education is a common intersection point for the private sector and governments. Construction, operation, and maintenance jobs are constantly evolving, changing, and expanding as new standards, best practices, and methods enter the market landscape. Investing in a skilled and quality-oriented workforce helps protect the industries's reputations. While funding by national or local governments may be required to help train the first few waves of workers, maintaining and developing the skills necessary to keep them "masters of their craft" is the role of the private sector. This ongoing education will ensure that private-sector companies remain competitive.

Multinational Collaboration

Finally, strong international partnerships are also needed to help renewable energy technologies take root. The Organization of Eastern Caribbean States has already demonstrated the benefits of multinational collaboration. Though not exclusively focused on renewable energy development, the Electronic Government for Regional Integration Project is a collaborative effort among Grenada, Dominica, and Saint Lucia, with more than $6 million in funding from the World Bank, to help improve government transparency, public–private business efficiencies, and the development of a more inviting business landscape for industries. The Grenadines and Saint Vincent are also considering joining the program. This initiative will help businesses expand across national borders and efficiently conduct business with multiple governments at once. A similar initiative dedicated to transparent renewable energy standards across national borders would help boost renewable energy in LAC.

Conclusion and Recommendations

Establishing and nurturing a comprehensive and strong renewable energy industry across such a vast landscape is no small challenge, yet the rewards are well worth the efforts. A well-constructed renewable energy industry brings jobs, energy security, education in science and technology, and modern infrastructure directly to the countries that need it most. On a much broader scale, nations will benefit from having a more skilled workforce, safer environmental conditions, increased trade opportunities, and improved multinational relations. Finally, and possibly most importantly, countries that invest in renewable energy will benefit from extraordinary savings on energy imports that can be re-invested in local economies rather than sent abroad. The global trend toward renewable energy is not just a market shift within the energy industry, but a broad re-orientation of society as we move into the future.

Because of the high cost of electricity, many countries in LAC are actively working to advance their renewable energy markets. Emergency solar lighting has been installed at Piarco International Airport in Trinidad and the Crown Point airport in Tobago (Bureau, 2009). In Grenada, national electricity provider GrenLec has adopted a 1:1 net metering practice that allows renewable energy system owners to be fairly compensated for the excess energy they produce and return to the grid. As a result, GrenSol, a leading solar company in Grenada, has installed PV systems on schools, homes, and commercial buildings (Schwerin, 2010). These are great success stories that prove renewable energy is starting to emerge as a solution. However, more work is clearly needed to maximize the capital investment, job creation, increased competitiveness, energy security, and clean air benefits associated with the development of vibrant renewable energy markets.

To advance renewable energy in LAC, the public sector should:

- Establish mechanisms that reduce the overall or upfront cost of installing renewable energy, including 1) third-party power purchase agreements; 2) property and sales tax exemptions; 3) solar leases; 4) feed-in tariffs; 5) national, state, and local rebate programs; 6) low-interest loan programs and micro-credit lending; and 7) net metering and other incentives to promote renewable energy technologies.
- Lead by example and establish committees, energy reduction targets, and renewable energy procurement goals for governments that will challenge the private sector. Example: Trinidad's Minister in 2009 appointed members to a Renewable Energy Committee (Singh, 2009).

- Establish goals to encourage stable and long-term market development. These goals can take the form of a national clean energy standard or a Renewable Portfolio Standard.
- Assess market potential and conduct resource inventory via mapping, and incorporate renewable energy goals into comprehensive planning.
- Promote programs through utility providers that allow residents and business owners to purchase renewable energy for their own consumption.
- Ensure that the infrastructure is in place for renewable energy to grow. This becomes more important as population and demand for energy increase.
- Work at gaining the trust and cooperation of utilities while encouraging non-monopoly business models to emerge.
- Ensure that there is competition within the private sector because competition keeps prices low and raises the level of quality and service.
- Recognize opportunities for the private sector to get involved and invite them.
- Provide new business and/or recruitment incentives.
- Work with the private sector to identify renewable energy industry needs and work in a collaborative and transparent way toward reducing barriers.
- Maintain flexible import/export trade laws.
- Carve out funding in the budget for renewable energy. Money that is saved through the implementation of energy efficiency measures can be set aside for renewable energy.
- Work across jurisdictional and national borders to ensure building and electric codes incorporate solar-friendly provisions and are neither redundant nor working at cross-purposes.
- Ensure that standardized permitting, interconnection, and inspection processes are in place. Regional coordination can increase efficiencies, reduce costs, and facilitate the overall process.
- Create certification/license standards for the installer workforce to ensure quality and safety.
- Mandate that children receive a balanced energy education that includes renewable energy.
- Train code officials to understand and be able to work with renewable energy technologies.
- Encourage public access of energy use data.
- Create an advisory team or steering committee to launch needs assessment and conduct baseline metrics data gathering and marketing campaign.
- Dedicate staff to advancing renewable energy programs.

- Facilitate the use of and/or sponsor micro-credit energy lending programs.
- Encourage the use of renewable energy for emergency preparedness. Schools and other public meeting places should have renewable energy in case of a natural disaster and/or evacuation.

To advance renewable energy in LAC, the private sector should:

- Organize and establish industry associations to work together on achieving mutual goals and holding the public sector accountable.
- Lead by example. Install renewable energy and then promote it and encourage replication of those efforts.
- Assess the region's strengthens and weaknesses and build off of them.
- Find a need and fill it by being entrepreneurial. The private sector is best suited for inventing, selling, and distributing renewable energy products and components. The private sector is also well suited for developing and owning renewable energy projects, producing informational and educational products (either for sale or for free public consumption), and producing financial products.
  - Examples of informational products that can be customized for LAC include
    - Centralized database like DSIRE (www.dsireusa.org), which tracks policies and regulations.
    - Centralized database like SolarHub (www.solarhub.com), which is a free reference guide of solar equipment specifications.
    - Resource inventory mapping like 3Tier (www.3tier.com).
    - Standardized permitting and business operations software like SolarNexus (www.solarnexus.com), a company whose business model revolves around improving processes for solar industry businesses.
  - Examples of financial products that can be customized for LAC include
    - Renewable energy cost calculators like PV Watts (http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/).
    - Bank loans like what Summit Credit Union offers residents in Milwaukee, Wisconsin (www.jsonline.com/business/126297198.html).
    - Micro-credit energy lending similar to what EarthSpark International and Fonkoze have set up in Haiti (www.earthsparkinternational.org/lending.html), enabling the purchase of more expensive energy systems.

Although regional approaches are highly recommended for the creation of codes, standards, and procedures (so that business can more easily flow between countries), it cannot be emphasized enough how each country in LAC deserves individualized examination, evaluation, and renewable energy market cultivation. That said, there has never been a better time to get started.

Acronym Key

kW = Kilowatt
kWh = Kilowatt Hour
AHJ = Authority Having Jurisdiction
MW = Megawatt
TWh = Terawatt Hour
GW = Gigawatt
LAC = Latin America and the Caribbean
DOE = U.S. Department of Energy
RPS = Renewable Portfolio Standard
REC = Renewable Energy Credit
SREC = Solar Renewable Energy Credit

Appendix A. Current Renewable Energy Incentives in LAC

	Feed-in tariffs	RPS	Capital subsidies, grants, rebates	Investment or other tax credits	Sales tax, energy tax, excise tax, or VAT reduction	Tradable renewable energy certificates	Energy production payments or tax credits	Net metering	Public investment, loans, or financing	Public competitive bidding
Argentina	X		X	O	X		X		X	X
Bolivia					X					
Brazil				X					X	X
Chile		X	X	X	X				X	X
Dominican Republic	X		X	X	X			W		
Ecuador	X			X						
El Salvador				X	X				X	
Guatemala				X	X					
Mexico				X				X	X	X
Nicaragua	X			X	X					
Panama							X			
Peru				X	X		X			
Uruguay		X								X

O = States or provinces have implemented the incentive, but it is not a national incentive. Source: REN21, 2011, page 60

W = Incentive is in progress of being developed/implemented. Source: Worldwatch Institute

Note: Table may be incomplete.

Appendix B. Current Renewable Energy Markets in LAC

Country	Signed Kyoto Protocol?	Biomass/ Biofuel	Wind	Geothermal	Hydropower	Solar
Antigua and Barbuda	Yes					
Argentina	Yes	•			•	
Bahamas	Yes					
Barbados	Yes		•			•
Belize	Yes					
Bolivia	Yes	•			•	
Brazil	Yes	•			•	•
Chile	Yes	•			•	
Colombia	Yes	•			•	
Costa Rica	Yes			•	•	
Cuba	Yes					
Dominica	Yes					
Dominican Republic	Yes	•				
Ecuador	Yes	•			•	
El Salvador	Yes	•		•	•	
French Guiana	No					
Grenada	Yes					•
Guatemala	Yes	•			•	
Guyana	Yes	•				
Haiti	Yes					
Honduras	Yes	•			•	
Jamaica	Yes	•	•			
Mexico	Yes	•		•	•	
Nicaragua	Yes	•		•	•	
Panama	Yes	•			•	
Paraguay	Yes	•			•	
Peru	Yes	•			•	
Puerto Rico	No					
Saint Kitts and Nevis	Yes					
Saint Lucia	Yes					•
Saint Vincent and the Grenadines	Yes					
Suriname	Yes	•			•	
Trinidad and Tobago	Yes					
Uruguay	Yes	•			•	
Venezuela	Yes				•	

Note: Table may be incomplete.
Sources: Meisen and Krumpel, 2009; REN21, 2011.

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